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## Wildlife Services National Wildlife Research Center

### Leader in Nonlethal Wildlife Damage Solutions



#### USDA Scientists Apply Wildlife Biology Expertise to Wildlife Conflicts

The Wildlife Services National Wildlife Research Center (NWRC) is a world leader in providing science-based solutions to complex issues of wildlife damage management. As the research arm of the Wildlife Services (WS) program, NWRC works with WS operations staff to provide Federal leadership and expertise to resolve wildlife conflicts related to agriculture,

livestock, human health and safety (including wildlife diseases), invasive species, and threatened and endangered species. In 2006, approximately 75% of NWRC's funding was spent on efforts to develop or improve nonlethal wildlife damage management tools and methods. In fact, many of the nonlethal methods used today by Federal, State, and private sector wildlife professionals stem from research conducted at or through the Center.

#### Protecting Agricultural Crops, Aquaculture, and Natural Resources

NWRC is committed to finding nonlethal solutions to reduce wildlife damage to agricultural crops, aquaculture, and natural resources. In the 1980's, NWRC scientists showed that "decoy" plantings of sunflower could significantly reduce bird damage to nearby commercial sunflower fields. For a variety of logistical and economic reasons, however, decoy sunflower

fields did not become widespread. Over the last decade, new Federal farm programs have placed more emphasis on wildlife conservation leading to a renewed interest in the use of decoy fields. Recent studies showed blackbird and nonblackbird densities were greater in decoy fields versus commercial sunflower or small-grain fields. Wetlands were positively related to blackbird density, while shelterbelts and some weed plants were positively related to non-blackbirds. Producers seeking to maximize decoy use by blackbirds should keep weeds to a minimum in decoy plots and place the plots near wetlands. NWRC researchers are continuing to gather data to support the use of decoy fields as a broad-based, dual-purpose wildlife management strategy that not only reduces blackbird damage but also provides habitat for wildlife.

NWRC is also working with numerous partners to reduce bird damage to rice crops and increase profitability to growers. NWRC scientists conducted tests with both captive and free-ranging blackbirds to identify and develop nonlethal repellants for reducing bird depredation on seeded and ripening rice. Of many chemicals tested, GWN-4770, GWN-4140, caffeine, and Tilt® EC have shown the most promising results.

In addition to damaging agricultural crops, birds can also cause a great deal of damage at fish farms and other aquaculture facilities. Currently, NWRC is studying the migratory movements and feeding behavior of fish-eating

birds, especially double-crested cormorants. With this knowledge, NWRC is perfecting the use of low-powered, nonlethal lasers to disperse cormorants from night roosts near fish farms.

Foraging wildlife, such as deer, can damage forest resources in many ways, such as reducing productivity or disrupting re-vegetation efforts. NWRC researchers discovered that certain food-grade materials, such as milk casein and egg albumen, have great potential as repellants to reduce deer consumption of desirable resources. Chemical analyses further demonstrated that proteins, which deter browsing deer, share the attribute of containing the amino acid methionine in their structures. A study evaluated several methionine-containing proteins by applying them to desirable plants and offering them to captive deer. The results of these experiments suggest that a repellant formulated with purified hydrolyzed casein used for nutritional and health applications effectively reduces browsing damage and is a promising tool for protecting seedlings in reforested areas.

### **Protecting Human Health, Safety and Property**

NWRC works to protect human health and property by developing wildlife damage management tools that help reduce wildlife hazards. Wildlife that linger around airport runways are an ongoing concern for many airport managers. Given avian responses to signal colors and the importance of motion

detection to birds, there is potential for the integration of light-based techniques (i.e., via specific wavelengths or colors, pulse rates, or combinations thereof) in reducing bird collisions with aircraft. In an experiment to study avian avoidance behavior, NWRC biologists monitored avian responses to specific lighting treatments and an approaching ground-based vehicle by using a complex video surveillance system. The recorded images were played back to determine the time and distance over which individual birds reacted to specific lighting treatments. Results will aid in the development of new light-based scare devices for birds.

As goose populations and urban areas expand and overlap, Canada geese are often considered a nuisance and potential health problem (fouling land and water, colliding with and damaging aircraft, etc.). Nonlethal and humane means of managing the size of Canada goose flocks in urban areas are needed. In 2006, NWRC received final regulatory approval and registration by the Environmental Protection Agency (EPA) for OvoControl-G, an oral contraceptive bait for Canada geese. The contraceptive bait was developed by NWRC in cooperation with Innolytics, LLC, a California-based company and manufacturer of the product. OvoControl contains nicarbazin, an active ingredient traditionally given to broiler chickens to prevent the disease coccidiosis. A side effect of nicarbazin is decreased egg production and hatching rates. When fed to Canada geese during their breeding season,



OvoControl effectively reduces the hatching success of eggs. When it is withdrawn from the diet, egg production and hatchability return to normal within a few days. NWRC received the Notable Technology Development Award in 2005 from the Federal Laboratory Consortium (FLC), Mid-Continent Region for their part in the development of OvoControl. OvoControl provides wildlife managers with a new and humane tool for managing resident Canada goose flocks.

Black bears that damage property and enter homes or businesses in order to get food are a significant concern for wildlife managers in suburban areas. NWRC is partnering with the Colorado Division of Wildlife and Colorado State University to better understand how the movement, behavior and to ecology of black bears in these areas relate to the management of human-bear conflicts. In 2005, bears were captured, fitted with Global Positioning System (GPS) collars, and monitored 24 hours a day to gather information on their movements and ecology. Subsequent years will focus on how management activities influence bear movement, behavior and ecology. In particular, researchers plan to evaluate the effectiveness of public education programs for reducing human-bear conflicts. One of the more long-term and sustainable strategies for reducing human-bear conflicts seems to be the elimination of human-related food sources, such as trash, bird-feeders, and pet food. This study will provide managers with a better

understanding of how bears have altered their ecology to take advantage of human food sources and how managers can most effectively invest their time and resources to reduce problems.

As the number of vultures increases throughout the south-eastern United States so does the number of vulture-human conflicts. Black vultures damage vinyl, plastic, and other synthetic construction and insulation materials. Additionally, black vultures prey on newly-born livestock and, in association with turkey vultures, form roosts that not only are nuisances to people but also contribute to human health and safety problems. To help alleviate these problems, NWRC researchers successfully tested the effectiveness of an artificial vulture effigy in dispersing birds from roosting sites in Florida. Following the installation of the effigies at several sites, vulture populations decreased by 84%. NWRC researchers also tested the effectiveness of several commercially available perching deterrents. Four of these—an electrical track; sharp, dense metal spikes; a cylindrical rolling perch; and a motion-activated sprinkler—proved very effective in preventing vultures from perching on roofs in test pens.

Current NWRC research also protects human health by developing methods to reduce or eliminate disease transmission among wildlife, domestic animals, and humans. For example, NWRC scientists have been testing potential chronic wasting disease (CWD) inactivating enzymes in collaboration with two

private sector partners, PrionTech, Ltd., and Novozymes Biotech, Inc. CWD is a fatal neurological disease that infects captive and wild cervids (e.g., deer, elk and moose). A study using a mouse model of prion disease was conducted to determine whether treatments that eliminate detectable prions using in vitro diagnostics also eliminate infective potential. Two of the enzymes tested were capable of destroying the infectivity of abnormal prions. Much work remains to be done in the development of enzymatic deactivation of prions; however, the research has led to some promising avenues for improvement. Developing an enzyme-based method for prion inactivation will provide a versatile tool for decontamination that may be useful for environmental, laboratory, animal-facility, food-processing, and medical situations.

In addition, NWRC has been active in the development and testing of wildlife rabies vaccines. Though rabies is well controlled in domestic animals, it is still cause for concern among wildlife populations. Since 1995, WS has been involved in a national rabies prevention and oral rabies vaccination effort. In support of this program, NWRC scientists conducted a pen study to determine the longevity of the oral V-RG (Merial, Ltd.) rabies vaccine that is currently being used by WS to combat rabies in raccoons. Results showed that the vaccine prevented rabies infection in many raccoons up to 18 months post-vaccination.

## Protecting Threatened and Endangered Wildlife

West Nile virus (WNV) entered the United States in 1999 and has spread across the country since that time. WNV is a vector-borne disease that amplifies in birds. While not all birds die if they become infected, WNV is caused by an extremely virulent pathogen. There is concern how this pathogen might affect threatened and endangered species. Researchers at NWRC carried out experimental infection tests on greater sage grouse (a potential species for listing under the Endangered Species Act) to determine their susceptibility to the disease and initiated pilot studies on new vaccines that might offer protection against the disease.

Prior to the initiating the studies, the investigators were required to house wild greater sage grouse in captivity for an extended period of time. This had never been accomplished. NWRC researchers were successful in keeping grouse for more than 7 months in captivity in the Center's flight pens. The success was even more remarkable in that the grouse showed lekking (reproductive) behavior in captivity and successfully bred. This has profound implications for conservation and captive-breeding efforts for this species.

Unfortunately, the experimental infection studies confirmed that sage grouse are highly susceptible to infection, dying within three days of exposure to WNV. However, earlier vaccine trials suggest some

protection against infection, offering the hope that small threatened sage grouse populations might be captured and vaccinated against the disease.

## Protecting Against Invasive Species

NWRC develops innovative strategies to minimize the impacts and spread of invasive wildlife species in the continental United States, its territories and nearby countries or islands. For example, the monk parakeet, an invasive species from South America, has become established in Florida and several other states. For unknown reasons, monk parakeets often select electric utility facilities as sites to build their large, bulky nests of twigs and other materials. This behavior frequently results in power failures as nest materials and birds come into contact with conductors. NWRC is investigating the potential use of DiazaCon (an oral contraceptive) as a nonlethal method for reducing monk parakeet populations. Results so far look promising, and nesting behavior and reproductive success are currently being monitored. NWRC researchers are also investigating the use of reproductive inhibitors to reduce the brown treesnake population on Guam where an overabundance of the invasive snakes has decimated native birds, bats, and reptiles.

The Gambian giant pouched rat (GGPR) has become an invasive species of concern for the State of Florida. In 2006, NWRC worked with Florida WS to develop infor-

mation for planning the species' eradication from Grassy and Crawl Keys, where it is currently established. In addition to having negative impacts on agricultural crops and native habitats, GGPRs could negatively impact populations of some threatened and endangered species, especially the endangered Key Largo woodrat, the Key Largo cotton mouse, and the Lower Keys marsh rabbit. A pilot eradication campaign on Crawl Key, employing population monitoring methods developed by NWRC, was carried out in spring of 2006. Recent camera surveys indicated no GGPR survival following Hurricane Wilma and the pilot eradication effort. As a result, eradication efforts will now focus on the primary population on Grassy Key. The first step in the eradication process will be to monitor Grassy Key using a camera-indexing methodology. This setup will determine current GGPR distributions and relative abundances throughout the island. Subsequent steps will include the construction and deployment of bait stations especially designed to exclude native species.

In 2006, NWRC completed the construction of a new APHIS WS Invasive Species Research Building located at NWRC's headquarters site on the Foothills Research Campus of Colorado State University in Fort Collins, CO. The building expands and enhances NWRC's ability to study the ecology, biology, behavior and physiology of invasive wildlife species and to develop management tools and strategies for mitigating damage and controlling

the spread of invasive species. The 25,000-square-foot building has the ability to simulate temperature and humidity ranges from temperate to tropical ecosystems. The flexibility of the environmental controls allows for the year-round study of invasive vertebrate species from all types of climates. Examples of invasive species that will be studied include brown treesnakes from Guam, Coqui frogs from the Caribbean, GGPR from western Africa, Monk parakeets from South America, roof rats from Southeast Asia, and nutria from South America.

## Protecting Livestock

Protecting livestock from predators is an important part of WS' mission. The need for acceptable and effective predator management tools is imperative in order to protect public safety and reduce livestock losses. Recent restrictions on the use of traps have led NWRC to test a wider array of nonlethal tools and methods that minimize predation on livestock.

NWRC's Logan field station and ML Designs of Goleta, CA, have developed Scare-Call, a new remotely activated, multisensory, programmable device that can be used either to frighten or call predators. The initial concept for the tool came from consultations with WS Operations in several States, but additional research added significant capabilities to the device. Currently, the device can be programmed weeks in advance and left in the field. It can also be triggered

or remotely programmed from hundreds or yards away. Scare-Call uses high-quality digital audio files and can respond to inputs, such as motion detectors, or use external outputs, such as lights and external speakers. The use of the device near pastures could potentially reduce predation on livestock by wolves, coyotes and other large predators.

The scientists working at NWRC are dedicated to resolving conflicts that arise between people and wildlife. Through their efforts, NWRC scientists provide WS field biologists, and those who struggle with wildlife damage, an array of tools and methods that they can employ and adapt to resolve wildlife conflicts. NWRC scientists are concerned about the welfare of all animals, and they look for solutions that are biologically sound, environmentally safe, and socially acceptable. This critical research ensures that the broadest array of wildlife damage management tools will continue to be available for use by WS biologists, as well as State wildlife agency professionals, landowners, and others.

## Selected Publications

- Breck, S. W.; Lance, N.; Callahan, P. 2006. A shocking device for protection of concentrated food sources from black bears. *Wildlife Society Bulletin* 34: 23–26.
- Engeman, R. M.; Woolard, J.; Perry, N. D.; Hardin, S.; Brashears, L.; Smith, H.; Muiznieks, B.; Constantin, B.; 2006. Rapid assessment for a new invasive species threat: the case of the Gambian giant pouched rat in Florida. *Wildlife Research* 33: 439–448.
- Kimball, B. A.; Nolte, D. L. 2006. Development of a new deer repellent for protection of forest resources. *Western Journal of Applied Forestry* 21: 108–111.
- Linz, G. M.; Homan, H. J.; Slowik, A. A.; Penry, L. B. 2006. Evaluation of registered pesticides as repellants for reducing blackbird (Icteridae) damage to sunflower. *Crop Protection* 25: 842–847.
- Shivik, J. A. 2006. Tools for the edge: what's new for conserving carnivores. *BioScience* 56: 253–259.
- Bynum, K. S.; Yoder, C. A.; Eisemann, J. D.; Johnston, J. J. Miller, L. A. 2005. Development of nicarbazin as a reproductive inhibitor for resident Canada geese. In D. L. Nolte; K. A. Fagerstone, eds. In: Nolte, D. L.; Fagerstone, K. A., eds. *Proceedings of the 11th Wildlife Damage Management Conference*; 16–19 May 2005; Traverse City, MI. Fort Collins, CO: Wildlife Damage Management Working Group, The Wildlife Society: 179–189.
- Hagy, H. M.; Raetzman, J. M.; Linz, G. M.; Bleier, W. J. 2005. Decoy cropping methods for luring blackbirds away from commercial sunflower: USDA wildlife conservation sunflower plots. In: Nolte, D. L.; Fagerstone, K. A., eds. *Proceedings of the 11th Wildlife Damage Management Conference*; 16–19 May 2005; Traverse City, MI. Fort Collins, CO: Wildlife Damage Management Working Group, The Wildlife Society: 304–310.

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## Wildlife Services Protects through Scientific Research

### Notable Examples of Significant Research

The National Wildlife Research Center (NWRC) is a world leader in providing science-based solutions to complex issues of wildlife damage management. As the research arm of the Wildlife Services (WS) program, NWRC works with WS operations staff to provide Federal leadership and expertise to resolve wildlife conflicts related to agriculture, livestock, human health and safety (including wildlife diseases), invasive species, and threatened and endangered species.

Wildlife Services (WS) is a science-based program that relies on research and other independent reviews to assess the need for wildlife damage management, the potential impacts of field work, and the costs and benefits associated with program work. Below are several notable studies compiled by WS and independent organizations that highlight the importance and need for WS' assistance in resolving conflicts involving wildlife.



#### 1. Relatedness of swift fox

Kitchen, A.M.; Gese, E.M.; Waits, L.P.; Karki, S.M.; Schauster, E.R. 2005. Genetic and spatial structure within a swift fox population. *Journal of Animal Ecology* 74:1173-1181.

Kitchen et al. (2005) recorded the space use patterns of 188 radio-collared swift foxes in southeastern Colorado from January 1997 to December 2000. One hundred and sixty-seven foxes were also genotyped and the degree of relatedness between individuals was estimated.

The data suggested that swift fox populations are genetically structured at a fine-scale with kin clustering evident. Neighbors were related more closely than expected from the average population relatedness. The authors proposed that the clustering among kin in the swift fox populations has led to an increased level of tolerance among neighbors, thereby reducing the costs inherent in home-range defense and increasing the likelihood that empty ranges were inherited by related foxes.



## 2. A review of tools for conserving carnivores.

Shivik, J.A. 2006. Tools for the edge: what's new for conserving carnivores. *BioScience* 56:253-259

Shivik (2006) provided a review of various management tools used to mitigate conflicts between humans and predators, such as wolves, coyotes, and bears. Both disruptive-stimulus (e.g., fladry, Electronic Guards, radio-activated guards) and aversive-stimulus (e.g., electronic training collars, less-than-lethal ammunition) were reviewed. Shivik discussed not only the biological and economic efficiency of these methods, but also noted that social and psychological effects must be considered when selecting a tool. He also notes that efficient protection of American agriculture is also essential for conservation of carnivores.

## 3. New tools for aging birds.

Fallon, J.A.; Cochrane, R.L.; Dorr, B.S.; Klandorf, H. 2006. Interspecies comparison of pentosidine accumulation and its correlation with age in birds. *Auk* 123: 870-876.

Many avian and mammal species are difficult to age accurately based on physical characteristics and their population demographics can only be understood from long-term banding and marking programs and captive animals. Pentosidine (Ps) is a stable, fluorescent biomarker that has been found to accumulate with age in the skin collagen of a variety of birds and mammals. In this study, Fallon et al. collected and analyzed skin samples from the breasts of 52 ruffed grouse (*Bonasa umbellus*) and 19 double-crested cormorants (*Phalacrocorax auritus*) to investigate the potential use of Ps as a biomarker to estimate the chronological age of these two species. Results showed a significant relationship between age and Ps accumulation in grouse and cormorants. This aging technique can provide for relatively rapid collection of age information and associated population demographics that could aid species management, conservation, and restoration programs.

## 4. Food detection in birds.

Schaefer, H.M.; Levey, D.J.; Schaefer, V., Avery, M.L. 2006. The role of chromatic and achromatic signals for fruit detection by birds. *Behavioral Ecology* 17:784-789.

In this study, Schaefer et al. assessed how wavelength- (chromatic) and intensity-related (achromatic) contrasts between fruit and background colors (i.e., sand versus foilage) determine the detectability of fruit by birds. Two experiments using free-flying crows (*Corvus ossifragus*) revealed that crows detected both artificial black and red fruits equally, suggesting that they used chromatic contrasts to detect UV-reflecting berries and achromatic contrasts to detect black berries. The birds prioritized chromatic contrasts when searching for artificial red fruits in foliage, but not when searching for blueberries on sand. The authors concluded that visual signals are more complex than commonly assumed and that the relative importance of chromatic and achromatic contrasts is contingent on the background. Therefore, they suggest that models of signal perception can be improved by incorporating background-specific effects. This, in turn, could result in improved bait delivery systems for exposing birds to chemosterilants or lead to better methods for making crops less detectable to depredating birds.

## **5. Impacts of predation management on sea turtle conservation.**

Engeman, R.M.; Martin, R.E.; Smith, H.T.; Woolard, J.; Crady, C.K.; Constantin, B.; Stahl, M.; Groninger, N.P. 2006. Impact on predation of sea turtle nests when predator control was removed midway through the nesting season. *Wildlife Research* 33:187-192.

Hobe Sound National Wildlife Refuge (HSNWR) on Jupiter Island along Florida's coast provides undeveloped and protected beach habitat for nesting by loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*) and green (*Chelonia mydas*) turtles, each of which is federally listed as threatened or endangered. Raccoons and armadillos are serious nest predators at HSNWR. Consequently, predator removal was identified as the most important management program at the beach. In this study, Engeman et al. evaluated the impact on nest predation resulting from removal of predator control midway through the nesting season in 2004. Results showed that predation during only three-quarters of the 2004 nesting/hatching season substantially out-paced predation for the entire season in the two preceding years when predation management was in place.

## **6. Avian influenza in wild birds.**

Clark, L.; Hall, J. 2006. Avian influenza in wild birds: status as reservoirs and risks to humans and agriculture. *Ornithological Monographs* 60:3-29.

Clark and Hall (2006) discussed avian influenza ecology, evolution from low- to high-pathogenic forms, modes of transmission, zoogeography, risks to humans and biosecurity at domestic poultry facilities. The authors noted although there is little anyone can do about the natural reservoir of AI in birds, increased information about how the viruses are maintained, transmitted and moved across the landscape in nature would provide valuable information about agricultural and human-health risk assessment.

## **7. Role of raccoon in bovine tuberculosis transmission.**

VerCauteren, K.; Smith, H.; Stevenson J. 2005. The role of raccoons in the ecology of bovine tuberculosis. *Proceedings of the Wildlife Damage Management Conference* 11:46-48.

Bovine tuberculosis is a contagious bacterial disease that has had significant socioeconomic impacts on the region of northern lower Michigan. VerCauteren et al. (2005) investigated the role raccoons may play in the ecology and maintenance of the disease on farms. Preliminary results of 61 radio collared raccoons yielded a better understanding of raccoon movement and habitat use within an agricultural complex. Preliminary analysis of raccoons suggested annual home range sizes of 0.824km<sup>2</sup> and 0.608km<sup>2</sup> for males and females, respectively. Additionally raccoons and cattle were documented at resource interfaces, further illustrating the potential for disease transmission among species. Results highlight the importance for farmers and wildlife managers to address raccoons and other medium-sized mammals when developing on-farm biosecurity strategies.



## **8. New repellent for reducing deer browsing on plants: hydrolyzed casein.**

Kimball, B.A.; Nolte, D.L. 2006. Development of a new deer repellent for the protection of forest resources. *Western Journal of Applied Forestry* 21:108-111.

In this study, Kimball and Nolte conducted several experiments toward the development of a new repellent to minimize deer browsing to commercial and ornamental plants. Casein (methionine-containing milk protein), hydrolyzed casein (same protein after hydrolysis), albumin (egg protein), soy flour (plant protein) and methionine (essential amino acid) were tested with captive deer. Hydrolyzed casein (HC) was shown to be less palatable to the deer than the other protein sources or free amino acid. Deer preference for conifer seedlings treated with repellent solutions varying in HC concentration demonstrated that a 12% HC repellent solution would effectively reduce deer damage to forest resources. Furthermore, a 12% HC deer repellent would cost 50 to 70% less than commercially available deer repellents.

## **9. Gaining a better understanding of wildlife rabies control through modelling.**

Sterner, R.T.; Smith, G.C. 2006. Modelling wildlife rabies: transmission, economics, and conservation. *Biological Conservation* 131:163-179.

Rabies is a fatal disease of mammals. Modelling affords scientists an inexpensive way to study key parameters of wildlife rabies transmission, rabies management economics, and threatened mammal (TM) conservation. Sterner and Smith (2006) described key aspects of rabies-transmission models in wildlife; promoted the use of a “threshold successful contact” rate (CT) to predict disease persistence; reviewed selected oral rabies vaccination (ORV) strategies, economic studies, and benefit–cost models associated with the use of ORV as a means of rabies control in non-TM situations; and discussed implications of these models to the conservation of TM. The authors recommended five steps to improve modeling of rabies transmission (wildlife disease in general), rabies-control economics, and TM conservation. The review inferred that early, localized culling, combined with ORV, will aid rabies control efforts with wildlife.

## **10. Use of the GnRH vaccine in feral swine.**

Killian, G.; Miller, L.; Rhyan, J.; Doten, H. 2006. Immunocontraception of Florida feral swine with a single-dose GnRH vaccine. *American Journal of Reproductive Immunology* 55:378-384.

In this study, Killian et al. evaluated the effectiveness of a single-shot GnRH immunocontraceptive vaccine in both male and female feral swine. After 36 weeks, none of the 2000-ug-treated females were pregnant and only 20% of the 1000-ug-treated females were pregnant. Males were less responsive to the vaccine than females. The authors concluded that the single-shot vaccine was effective in reducing fertility in a mixed population of male and female feral swine and may be useful for contraception and disease control of feral swine populations.